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A3V VRN VRQ

(56) Documents cited
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INT CL⁴ B60R

(71) Applicant
Autoflug GmbH & Co Fahrzeugtechnik

(Incorporated in the Federal Republic of Germany)

Industriestraße 10, 2084 Rellingen 2,
Federal Republic of Germany

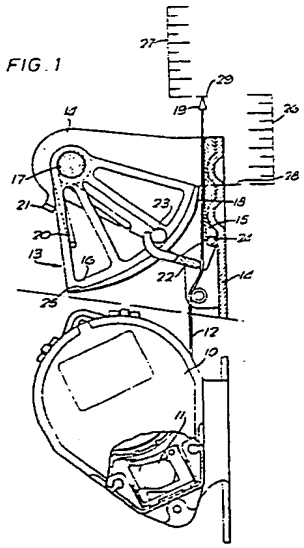
(72) Inventors
Gerhard Sedlmayr
Klaus Struck

(74) Agent and/or Address for Service
Frank B Dehn & Co
Imperial House, 15-19 Kingsway, London, WC2B 6UZ,
United Kingdom

(54) Safety belt restraining apparatus

(57) Safety belt restraining apparatus, e.g. for motor vehicles, has belt reeling means 10, a clamping device 13 having two clamping jaws 15, 16 between which the belt 12 is guided, to prevent withdrawal of the belt, and a sensor 22, 23, 24 for initiating the blocking action of the restraining means. The forces of acceleration which occur during clamping of the belt are to be limited or removed. The apparatus includes means arranged to become operative on actuation of the clamping device and clamping of the belt 12, such means having a deformable construction, to permit the belt 12 to be withdrawn by a certain distance in the direction of pulling out of the belt. Thus a jaw may have a deformable clamping surface (Figs 1 to 5) or it may be resiliently mounted (Figs 6 and 7) or mounted on a sector mounted on a resilient spindle (Fig 8). A common housing for the reeling means and clamping device may be movable at its anchorage to absorb energy (Figs 9 and 10).

FIG. 1



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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FIG. 1

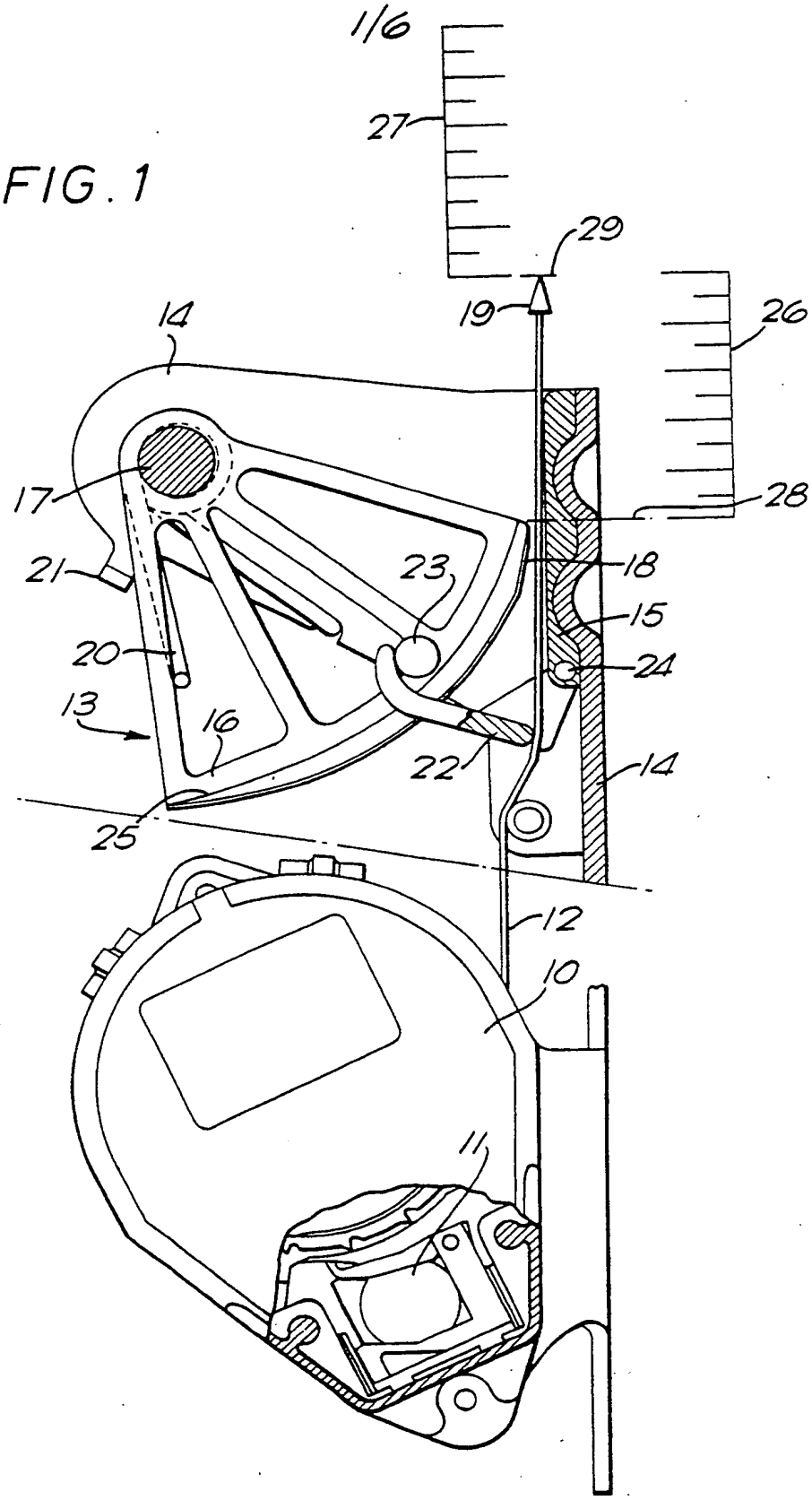

FIG. 2

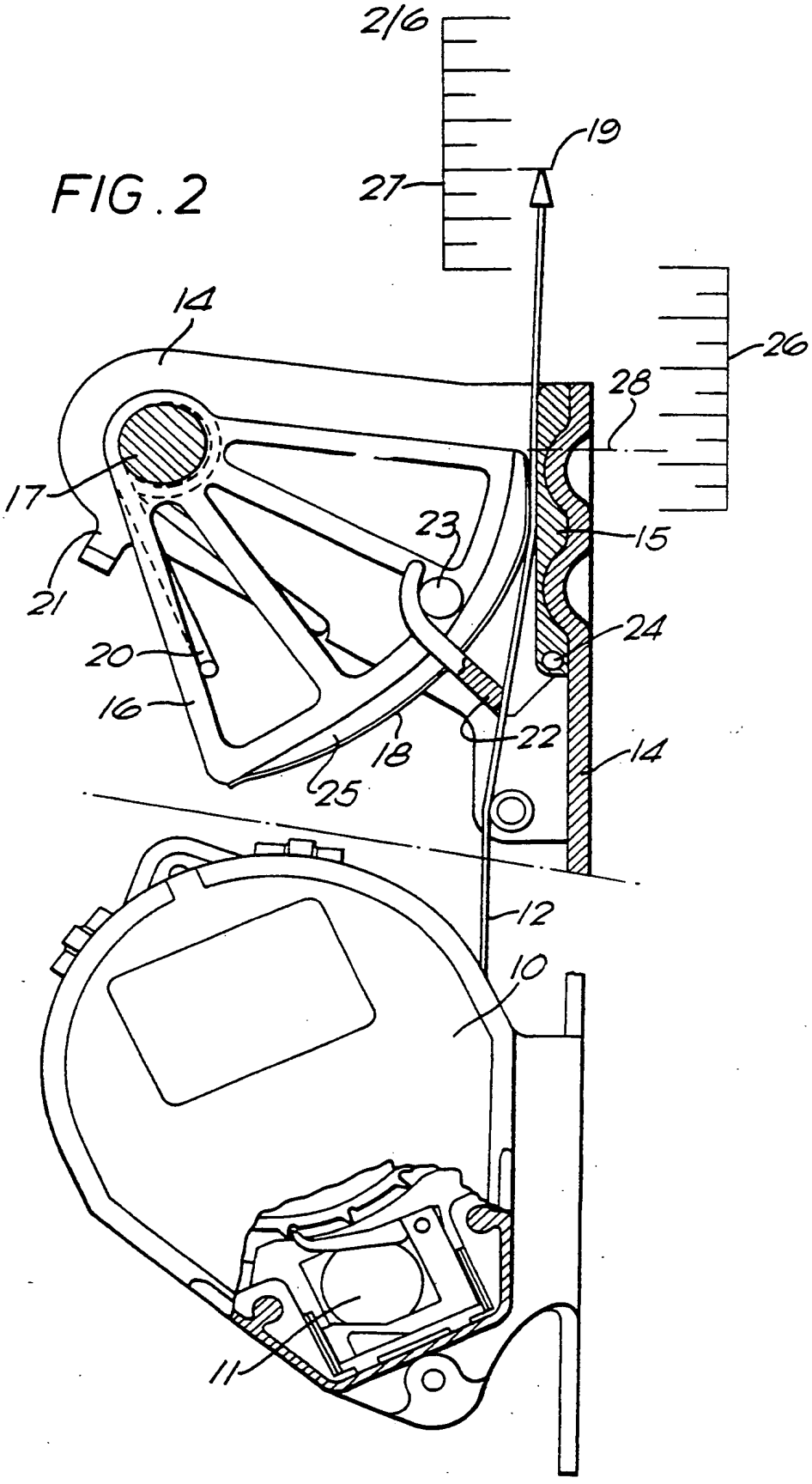

FIG. 3

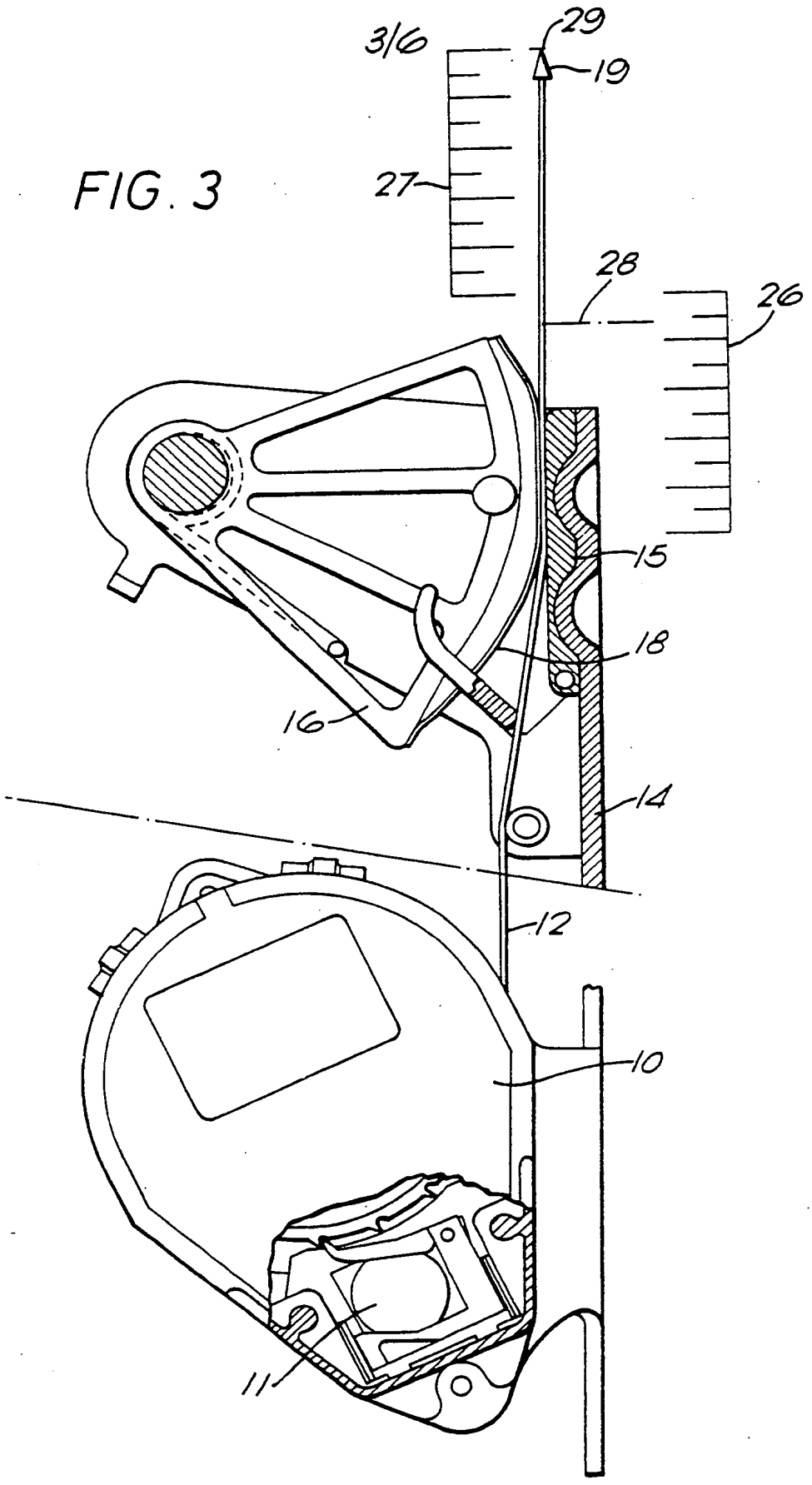

FIG. 4

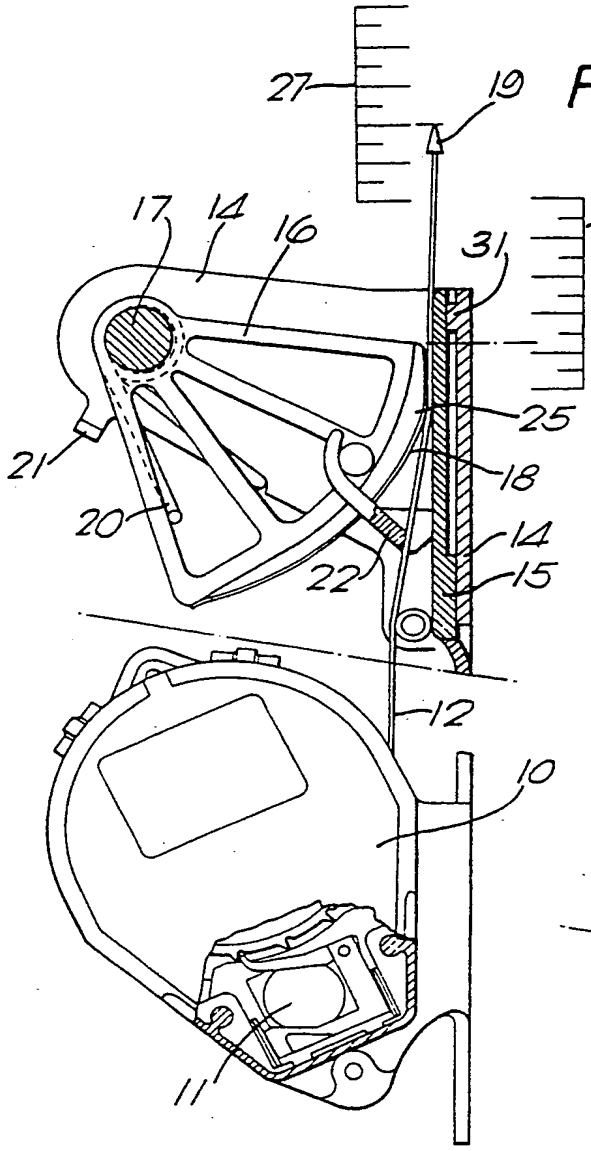
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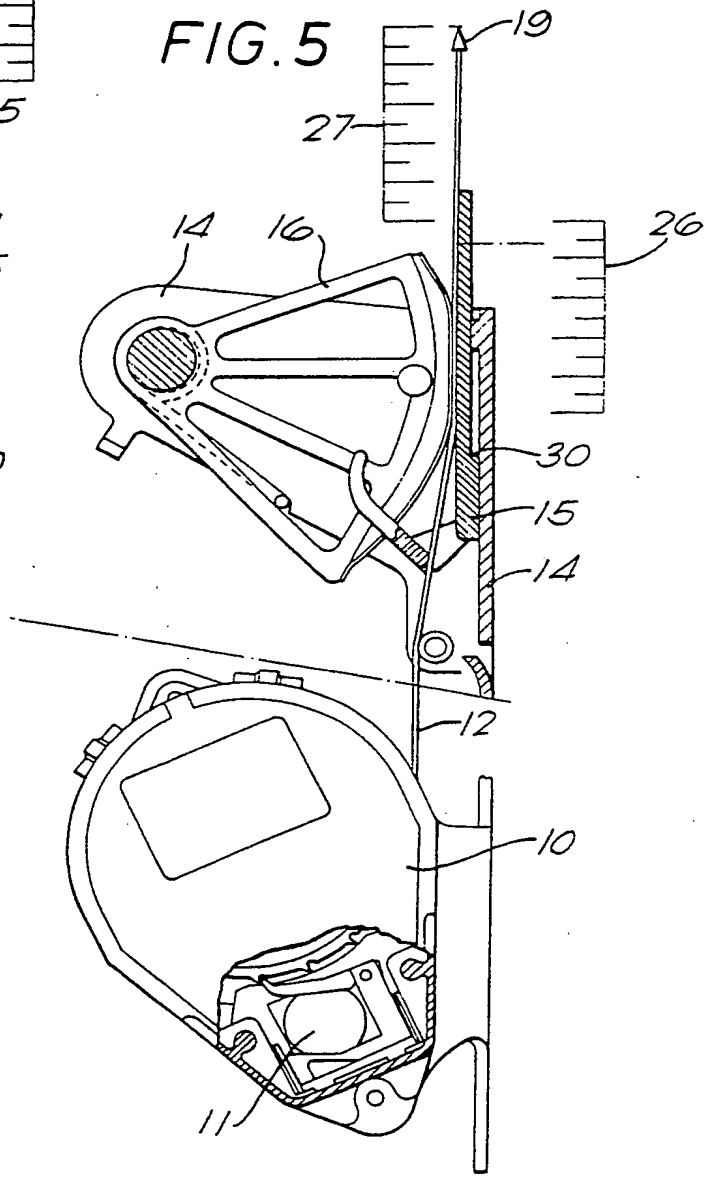
FIG. 5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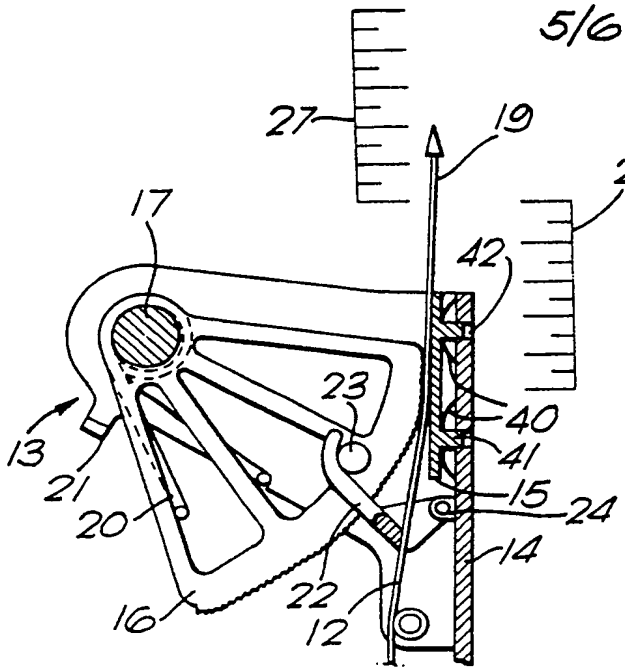

FIG. 6

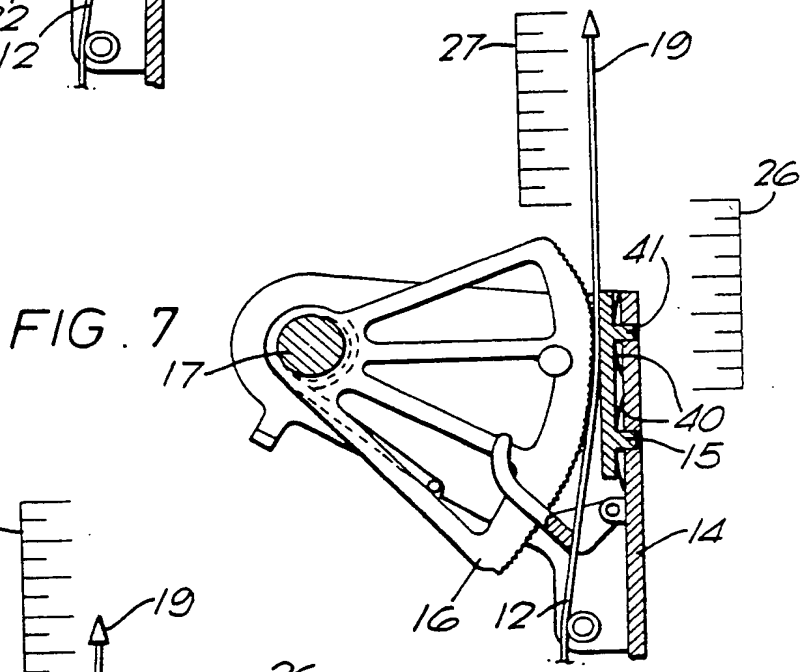

FIG. 7

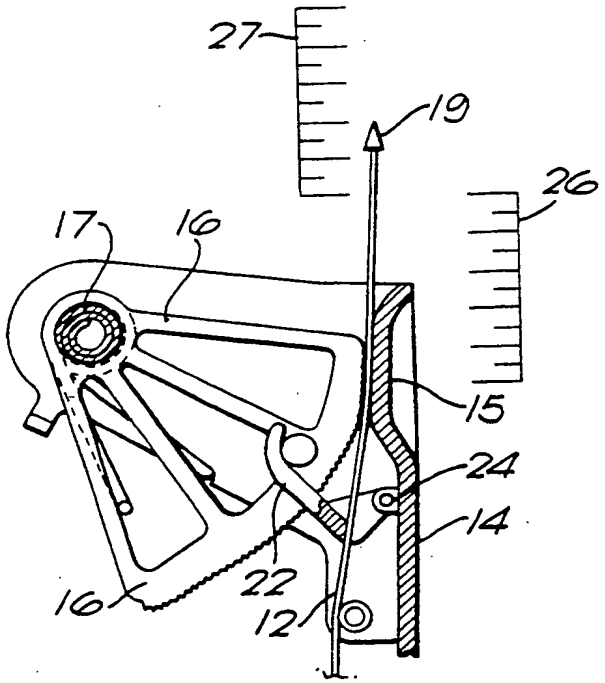

FIG. 8

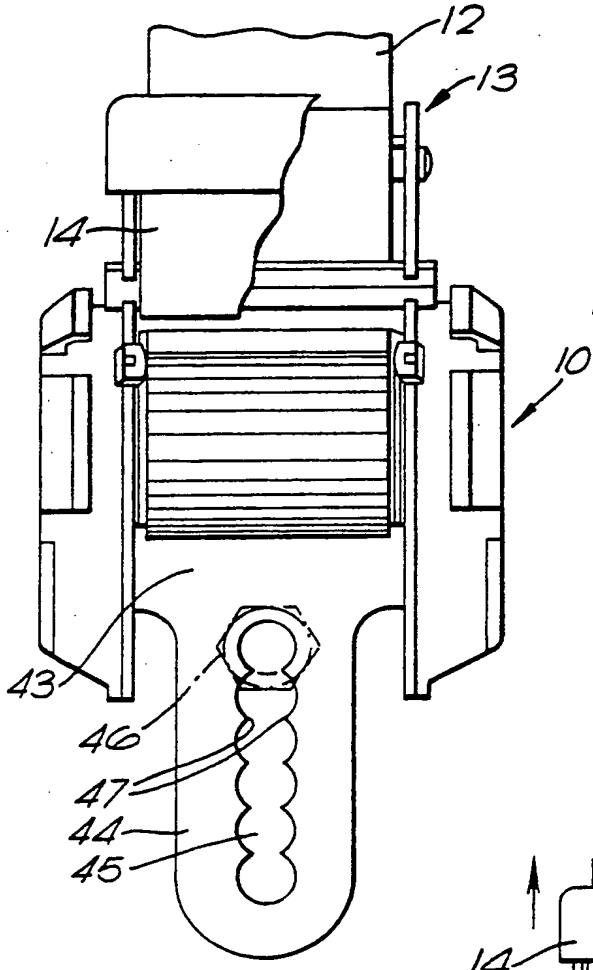

FIG. 9

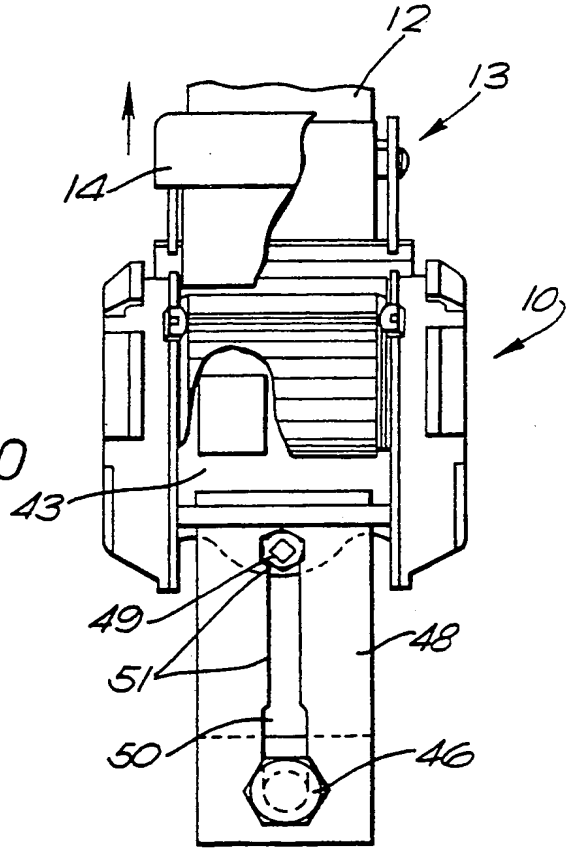

FIG. 10

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SAFETY BELT RESTRAINING APPARATUS

The invention relates to a safety belt restraining apparatus, for example for use in motor vehicles, comprising belt reeling means, a clamping device having two clamping jaws between which the belt is guided, for preventing the belt from being pulled out, and a vehicle-sensitive sensor for initiating the blocking action of the restraining apparatus.

Restraining apparatus of this kind is described in German OLS 36 24 569, in which the belt proceeding from a belt reeling means is passed through a clamping device which is provided either with one clamping jaw integral with the housing and one movable clamping jaw or with two movable and interactive clamping jaws. The clamping device is actuated by means of a vehicle-sensitive system which bring the clamping jaws into clamping abutment on the belt in response to braking of the vehicle.

An apparatus of this kind has the disadvantage that the abrupt stopping action of the clamping device exerts considerable acceleration forces on the body of the vehicle occupant wearing the belt. Since the body is restrained suddenly, the head of the wearer is subjected to particular acceleration, measured as so-called HIC values.

One aim of the invention is therefore to improve a restraining device of the kind described hereinbefore so that the forces of acceleration acting on the body of the vehicle occupant wearing the belt and occurring as the belt is clamped are limited or removed.

According to the invention there is provided safety belt restraining apparatus, comprising belt reeling means, a clamping device having two clamping jaws between which the belt is guided for preventing

the belt from being pulled out, a vehicle-sensitive sensor for initiating the blocking action of the restraining apparatus, and means arranged to become operative on actuation of the clamping device and clamping of the belt, such means having a deformable configuration to permit the belt to be withdrawn by a defined distance in the direction of pulling out of the belt.

Thus there is provided means arranged to become operative on actuation of the clamping device and clamping of the belt and which has a deformable configuration which p- -mits the belt to be withdrawn by a defined distance in the direction of pulling out of the belt. This advantageously means that after the clamping effect of the clamping jaws has started the belt is still released from the clamping device for a defined distance to begin with, and the clamping energy initially occurring is taken up by the deformation of the deformable component(s) provided accordingly on the clamping device.

In addition to the advantageous effect of limiting the acceleration forces, a preferred embodiment of the invention also has the advantage, in terms of the construction, that the force limiter is integrated in the clamping device and takes up only slightly more space, and no additional components are required as force limiters.

According to one embodiment of the invention, a movable clamping jaw of the clamping device is constructed as a clamping wheel, whilst the radius of the clamping wheel increases, in the region which cooperates with the opposing clamping jaw, counter to the direction of rotation of the clamping wheel, so that the spacing thus provided between the clamping jaws is reduced. Since a resilient lining is provided on the clamping wheel, as the clamping surface provided on the lining engages

with the belt this lining is increasingly deformed as the clamping wheel rotates, as a result of which the clamping energy is reduced or the restraining force is correspondingly gradually increased. After the initial clamping of the belt, therefore, a length of belt is released from the clamping device corresponding to the distance travelled by the clamping wheel.

In a preferred embodiment, the movable clamping jaw constructed as a clamping wheel is provided with a three-stage profile, namely, at the start, with a short portion of increasing radius for the first engagement of the clamping surface with the belt, a subsequent long portion of constant radius for breaking down the energy and, at the end, an end portion again with an increasing radius for producing the final clamping of the belt. The two portions at the beginning and end of the movable clamping jaw are of relatively short dimensions. The constant radius for the middle portion results from the fact that a constant counter-force of between 5,000 and 7,000 N is attempted, below which the belt is not normally fully arrested by the restraining means.

The advantageous effect of the arrangement of the clamping jaws can be further improved if the opposing clamping jaw is also movable over a given distance up to a limit.

According to another embodiment of the invention, a fixed clamping jaw of the clamping device is elastically mounted on the housing, either by means of resilient plate springs or by means of a layer of an elastomer. Another embodiment also provides that the spindle of the clamping wheel itself be of deformable construction so that when a force limit is reached at the start of the clamping process the spindle is compressed, so that the spacing of the rotation axis of the movable clamping wheel

from the fixed clamping jaw is increased and thus enables the clamping wheel to continue rotating by a predetermined amount, as a result of which again a predetermined quantity of belt is released from the clamping device in the direction of pulling out of the belt.

According to another embodiment the invention is also directed to a plate-shaped clamping jaw as the movable clamping jaw and, in such an embodiment, the plate-shaped clamping jaw is movable in a guide in the direction of pulling out of the belt, whilst this guide must permit displacement of the movable clamping jaw towards the opposing clamping jaw in order to reduce the spacing between the clamping surfaces and thus bring about firm clamping of the belt. The construction which becomes deformed whilst canceling out the energy can be provided not only in the region of the clamping surface but also in the region of the guide for the movable clamping jaw.

In an embodiment constructed in this way, the guide for the movable clamping jaw may advantageously be constructed in three stages so that, in addition to the progressively increasing clamping force, there is also a region with constant force.

The deformable configuration may, depending on the particular embodiment of the invention, be formed either by a deformable lining of rubber or plastics or by means of suitably arranged springs between a friction surface and the actual clamping jaw.

Two further embodiments of the invention are based on the idea of mounting the common housing of the belt reeling means and clamping device on a part which is integral with the vehicle, with the inclusion of a flexible distance with regard to the fixing means. Either the housing may have a slot provided in a fixing fishplate, this slot

being provided with narrowed portions which are widened, when a predetermined force is reached by the movement of the fixing means along the slot, with consequent work. According to a modification of this embodiment, the housing is secured on a metal plate mounted integrally with the vehicle by means of a fixing device in the form of a cutting blade and, when a predetermined load is reached, the fixing means cuts the metal plate over a certain distance, so that in both cases the movement of the housing of the belt reeling means with clamping the device in the direction of pulling out of the belt also releases a predetermined length of belt.

When determining the distance for release of the belt by the arrangement of the clamping jaws and the deformable components, a release distance of 50mm should not be exceeded, to ensure that the vehicle occupant wearing the belt is securely restrained by the part integral with the vehicle mounted in his seat area.

The invention is advantageously applicable to all kinds of clamping devices; it is particularly independent of the nature of the control of the clamping device by means of a vehicle-sensitive system. One or both clamping jaws may be controlled directly by a suitable sensor; however, a combination of the clamping device with a self-locking belt reeling means is also possible, the blocking action of which initially prevents further belt from being pulled out of the belt reeling means, after which the pull-out force occuring in the belt causes actuation of the clamping device.

In the case of a combination of clamping device with a self-locking belt reeling means with respect to the defined release of belt from the restraining device even after activation of the clamping device, can be taken to ensure that a corresponding length of belt can still be pulled

out of the belt reeling means, for example by providing a slip clutch, deformable components or the like in the region of the blocking system for the belt reeling means. Depending on the construction of the belt reeling means, more specifically a sufficiently great film spool effect can be achieved, which ensures that sufficient belt is made available for the defined release from the restraining means.

Finally, the clamping device may be arranged in known manner either in a housing which it shares with the belt reeling means or separately on a structural part integral with the vehicle.

Certain preferred embodiments of the invention will now be described by way of example and with reference to the accompanying drawings, in which:-

Fig. 1 is a side elevation of restraining apparatus with a clamping device and belt reeling means in the position of release;

Fig. 2 shows the apparatus of Figure 1 after activation of the clamping device in clamping engagement;

Fig. 3 shows the apparatus of Figure 1 in clamping engagement with release of the belt and energy conversion;

Fig. 4 shows another embodiment of restraining apparatus viewed as in Figure 2;

Fig. 5 shows the apparatus of Figure 4 in the position according to Figure 3;

Fig. 6 shows another embodiment of restraining apparatus in side elevation in an initial clamping position;

Fig. 7 shows the apparatus of Figure 6 in full clamping engagement;

Fig. 8 shows another embodiment of restraining apparatus viewed as in Figure 6;

Fig. 9 shows a front view of restraining apparatus with a common housing for the clamping device and belt reeling means before activation of the clamping device; and

Fig. 10 shows another embodiment of the restraining apparatus according to Fig. 4 after the end of the clamping movement.

From a belt reeling means 10 with a vehicle-sensitive triggering system 11 in the form of a known ball sensor the belt 12 is guided through a clamping device 13 having a clamping jaw 15 fixedly mounted on a housing 14 and a movable clamping jaw 16. The movable clamping jaw 16 is constructed as a clamping wheel which is mounted in the housing 14 so as to be rotatable about a rotation axis 17. On the clamping wheel 16 is formed a clamping surface 18 which extends over approximately a quarter circle. As can be seen from the position shown in Figure 1, the clamping surface 18 in the release position does not engage with the belt, since, with the clamping wheel 16 in a corresponding position based on the direction 19 of withdrawal of the belt 12, the closing surface only begins on a line 28 disposed perpendicularly to and centrally of the fixed clamping jaw 15 and then extends counter to the direction 19 of withdrawal.

The clamping wheel 16 in the non-clamping position shown in Figure 1 is pressed against an end stop 21 integral with the housing by means of a spring 20 and, for actuation, is connected to a belt rocker 22 which engages on a pin 23 of the clamping wheel 16. The belt rocker 22 is itself mounted on the lower end of the fixed clamping jaw 15 and is pivotable about a centre of rotation 24, whilst the belt 12 extending in a slightly bent configuration, is guided by the rocker 22 in such a way that when the belt 12 is tightened the rocker 22 is moved clockwise into an upwardly directed pivoting movement.

The radius of the clamping 16 increases from the beginning of the clamping surface 18 over a short initial area of about 10mm and then remains

constant over a middle portion, to increase again at the end of the clamping surface, so that, in associated positions of the clamping surface 18 to the fixed clamping jaw 15 the spacing between the associated clamping surfaces is reduced in two stages. The clamping surface 18 consists of a friction surface which, in the embodiment shown in the drawings, is applied to a deformable lining 25 located in turn on the clamping wheel 16. This lining 25 consists, for example, of rubber or a deformable plastics material and its thickness increases initially f ..m the start of the clamping surface 18 over the initial portion and then remains constant over a middle portion.

When the vehicle-sensitive sensor 11 responds, the belt reeling means initially blocks the further withdrawal of the belt 12, resulting in tightening of the belt 12 in the region of the rocker 22. As a result, the rocker 22 is pivoted upwardly about the centre of rotation 24 and thereby turns the clamping wheel 16 in the direction 19 of withdrawal of the belt; consequently, the clamping surface 18 is brought into contact with the belt 12 and clamps the latter against the fixed clamping jaw 15 (Figure. 2).

As the belt withdrawal force continues to act on the belt 12, the clamping wheel 16 now rotates further over the central area with the portion of the lining 25 of constant thickness, the level of force being determined by the admissible contact pressure and the elastisity. The clamping wheel 16 rolls over the fixed clamping jaw 15, whilst in accordance with the area covered, a specific length of belt 12 is also released in the direction 19 of withdrawal of the belt. When the clamping wheel 16 rolls over its central area, a uniform counter-force to the belt withdrawal force is established until the end portion reaches the fixed clamping

jaw and in this way the complete clamping of the belt 12 occurs with the clamping wheel 16 stationary, after which a stationary clamping state for the belt 12 is achieved.

In the drawings, the degree of freedom of the belt 12 in relation to the area covered by the clamping wheel 16 as it rotates with the clamping surface 18 is illustrated in the scales 26,27 the scale 26 illustrating the movement of the clamping wheel 16 and the scale 27 the corresponding withdrawal of the belt 12.

In the view shown in Figure 1, the clamping surface 18 is out of engagement with the belt 12. The start of the clamping surface 18 on the clamping wheel 16 being determined by the central perpendicular 28 based on the fixed clamping jaw 15 as the reference line. The position of the belt 12 in this initial position is indicated by the point of the arrow 19 and in the scale 27 at the reference line 29.

According to Figures 2 and 3 the belt withdrawal is to be completed by the displacement of the reference line 29 over the scale 27 and this withdrawal corresponds to the area of the scale covered by the reference line which determines the start of the clamping surface 18 on the clamping wheel 16 in the scale 26.

More specifically, the length of belt released should not exceed 50mm.

In Figures 4 and 5, in a corresponding view, the embodiment described above is modified in that here the opposing jaw 15 is no longer fixedly mounted but is movably mounted in the housing 14, the end stops 30 and 31 on the clamping jaw 15 and housing 14, respectively, determining the end position of the clamping jaw 15 in which the fully restraining clamping of the belt 12 occurs.

In the embodiment shown in Figure 6, the fixed clamping jaw 15 is mounted to be movable

towards the housing 14, with plate springs 40 arranged between the clamping jaw 15 and the housing 14. The clamping jaw 15 engages with projections 41 in corresponding recesses 42 in the housing 14 so as to permit displacement of the clamping jaw relative to the housing 14.

In conformity with the method of operation already described in connection with Figures 1 to 5, after activation of the clamping device with the belt withdrawal force still acting on the belt 12, the clamping jaw 15 now presses against the plate springs 40, which are resiliently deformed under the effect of the force, so that the clamping jaw 15 moves towards the housing wall 14 and enables the clamping wheel 16 to continue to rotate only with consumption of energy, so that, depending on the area covered by the clamping wheel (scale 26), a certain length of belt 12 (scale 27) is released in the direction 19 of withdrawal of the belt. If the clamping jaw 15 then abuts on the housing wall 14, the belt 12 is totally clamped with the clamping wheel 16 at a standstill, after which the belt 12 is in a stationary clamped state.

As can be seen from Figure 8, the clamping jaw 15 is mounted integrally with the housing, whilst the rotation axis 17 of the clamping wheel 16 is now constructed as a flexible component, the rotation axis being constructed, for example, as a spiral tensioning pin. When a force limit is attained as a result of the withdrawal force exerted by the clamped belt 12, the spiral tensioning pin is compressed, so that the spacing of the spindle 17 of the clamping wheel 16 to the fixed clamping jaw 15 is increased, as a result of which the clamping wheel 16 is only permitted to rotate over a predetermined distance.

Figures 9 and 10 show embodiments by way of example of the invention based on the premise

that the housing 14 of the clamping device 13 and a housing 43 of belt reeling means 10 are constructed as a common component and are attached to a part integral with the vehicle by means of a flexible fixing. For this purpose, as shown in Figure 9, the common housing 14, 43 has a securing fishplate 44 in which is provided a slot 45 for receiving a fixing member 46. The slot 45 has narrowed portions 47 at a spacing from the diameter of the fixing member 46. If a predetermined force is then exerted on the fixing point 46 by means of the belt withdrawal force, the housing 14, 43 is able to yield relative to the fixing member 46 in the direction of withdrawal of the belt by the distance predetermined by the length of the slot 45, whilst the fixing member 46 has to expand the narrowed portions 46, consuming energy. This provides the necessary absorption of forces and allows the belt to be pulled out a certain distance.

Finally the embodiment shown in Figure 10 corresponds to the one described in Figure 9 except that the housing 14, 43 is attached by means of a screw 49 to a metal plate which is fixedly secured, by the fixing member 46, to a vehicle part. The screw 49 passing through the metal plate 48 is constructed as a cutting blade which, in the resting position, rests in the extension 50 of the metal plate 48. After a predetermined force is exerted, the screw 49 cuts a slot 51 in the metal plate 48, so that the housing 14, 43 is movable at the fixing point in the direction 19 of withdrawal of the belt. For security, the screw 49 may also be guided in a slot formed in the part integral with the vehicle, the end of the slot in the part integral with the vehicle simultaneously serving as an end stop for the cutting movement of the screw 49 in the metal plate 48.

It is to be clearly understood that there are no particular features of the foregoing specification, or of any claims appended hereto, which are at present regarded as being essential to the performance of the present invention, and that any one or more of such features or combinations thereof may therefore be included in, added to, omitted from or deleted from any of such claims if and when amended during the prosecution of this application or in the filing or prosecution of any divisional application based thereon. Furthermore the manner in which any of such features of the specification or claims are described or defined may be amended, broadened or otherwise modified in any manner which falls within the knowledge of a person skilled in the relevant art, for example so as to encompass, either implicitly or explicitly, equivalents or generalisations thereof.

CLAIMS:

1. Safety belt restraining apparatus, comprising belt reeling means, a clamping device having two clamping jaws between which the belt is guided for preventing the belt from being pulled out, a vehicle-sensitive sensor for initiating the blocking action of the restraining apparatus, and means arranged to become operative on actuation of the clamping device and clamping of the belt, such means having a deformable configuration to permit the belt to be withdrawn by a defined distance in the direction of pulling out of the belt.

2. Apparatus as claimed in claim 1, wherein the clamping device comprises a movable clamping jaw constructed as a clamping wheel on which a clamping surface provided with a deformable lining extends over approximately a quarter circle, and the radius of the clamping wheel in the region over which the clamping surface extends increasing in the circumferential direction opposite the direction in which the clamping wheel rotates when the belt is pulled out.

3. Apparatus as claimed in claim 2, wherein the movable clamping jaw has a three-stage profile with an initial portion having an increasing radius, a middle portion having a constant radius and an end portion having an increasing radius.

4. Apparatus as claimed in claim 1,2, or 3 wherein one of the clamping jaws is mounted resiliently by means of plate springs or with the interposition of a layer of elastomer on a housing of the apparatus.

5. Apparatus as claimed in claim 2 or 3, wherein the mounting spindle of the clamping wheel is resiliently deformable.

6. Apparatus as claimed in claim 5, wherein the spindle of the clamping wheel is constructed as a spiral tensioning pin.

7. Apparatus as claimed in claim 1, wherein the clamping device comprises a movable clamping jaw of plate-shaped construction and displaceable towards an opposite jaw, the movable jaw being guided during displacement towards the opposite jaw in a guide with a deformable configuration.

8. Apparatus as claimed in claim 7, wherein the guide has an inclined surface which tapers in the direction of pulling out of the belt and this surface is arranged to act on the movable clamping jaw.

9. Apparatus as claimed in claim 8, wherein the guide is subdivided into three sections with an initial portion which reduces the spacing of the clamping surfaces, a middle portion with a constant spacing between the clamping surfaces and an end portion, again with a decreasing spacing between the clamping surfaces.

10. Apparatus as claimed in any preceding claim, wherein one of the clamping jaws is arranged to be movable in the direction of pulling out of the belt.

11. Apparatus as claimed in any preceding claim, wherein one of the clamping jaws is provided, in the region of its clamping surface, with a resilient lining the thickness of which increases in an initial portion of the clamping jaw, counter to the direction of pulling out of the belt, and remains unaltered in a subsequent portion.

12. Apparatus as claimed in claim 11 wherein the lining consists of rubber or a flexible plastics material.

13. Apparatus as claimed in any of claims 1 to 10, wherein one of the clamping jaws is provided with a friction surface for making contact with the belt, there being springs provided between the friction surface and the clamping jaw.

14. Apparatus as claimed in claim 1, wherein a housing of the clamping device and a housing of the belt reeling means are integrally formed and secured to a member adapted to be connected to a vehicle in such a way as to be displaceable relative to said member.

15. Apparatus as claimed in claim 14, wherein the housing has a securing fishplate with a longitudinal slot for receiving fixing means and wherein constrictions narrower than the diameter of the fixing means are formed in the longitudinal slot.

16. Apparatus as claimed in claim 14, further comprising a metal plate and means for securing the metal plate to a vehicle, and wherein the housing is fixed to the metal plate by a screw passing therethrough, the screw being arranged as a cutting blade for cutting the metal plate over a set distance.

17. Apparatus as claimed in any preceding claim wherein said defined distance for the belt is up to about 50 mm.

18. Seat belt restraining apparatus substantially as hereinbefore described with reference to Figures 1, 2 and 3 or Figures 4 and 5 or Figures 6 and 7 or Figure 8 or Figure 9 or Figure 10 of the accompanying drawings.